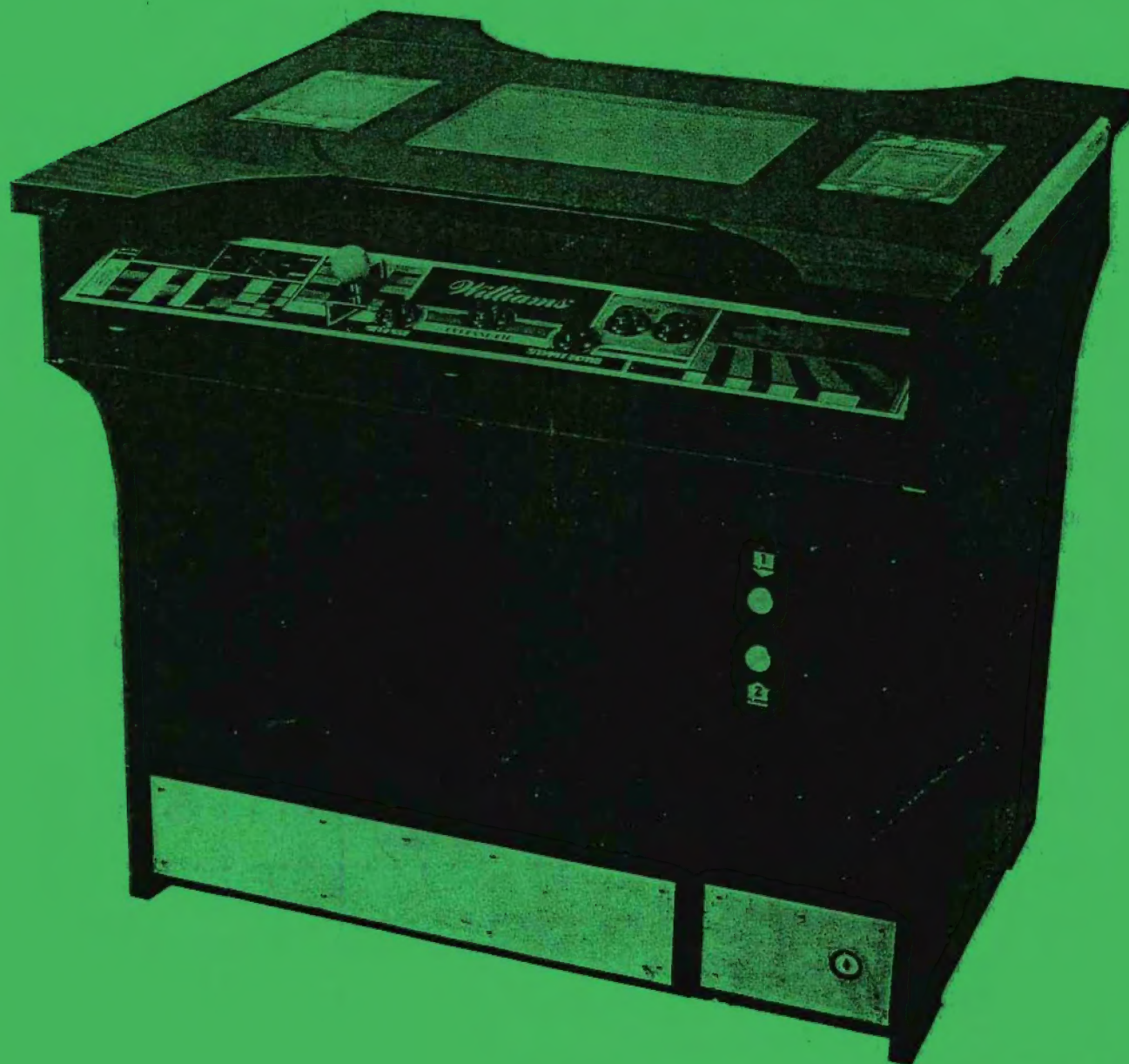


Williams®

16P-3001T-101
May, 1981

DEFENDER



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ELECTRONICS, INC.

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SPECIAL NOTES

CPU/Video Board

Model R8570 equipped with two decoder ROMs, must be used.

Interface Board

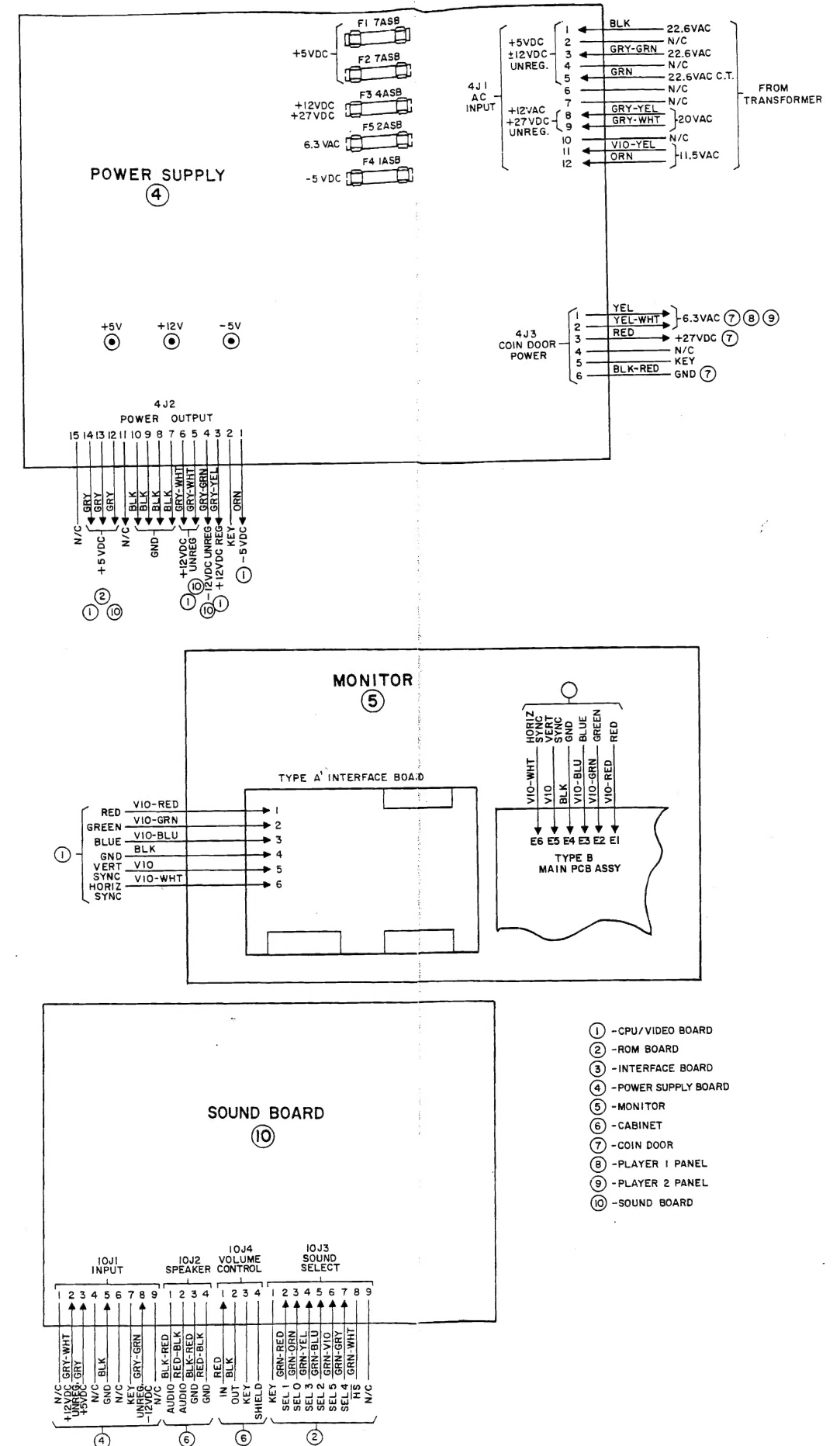
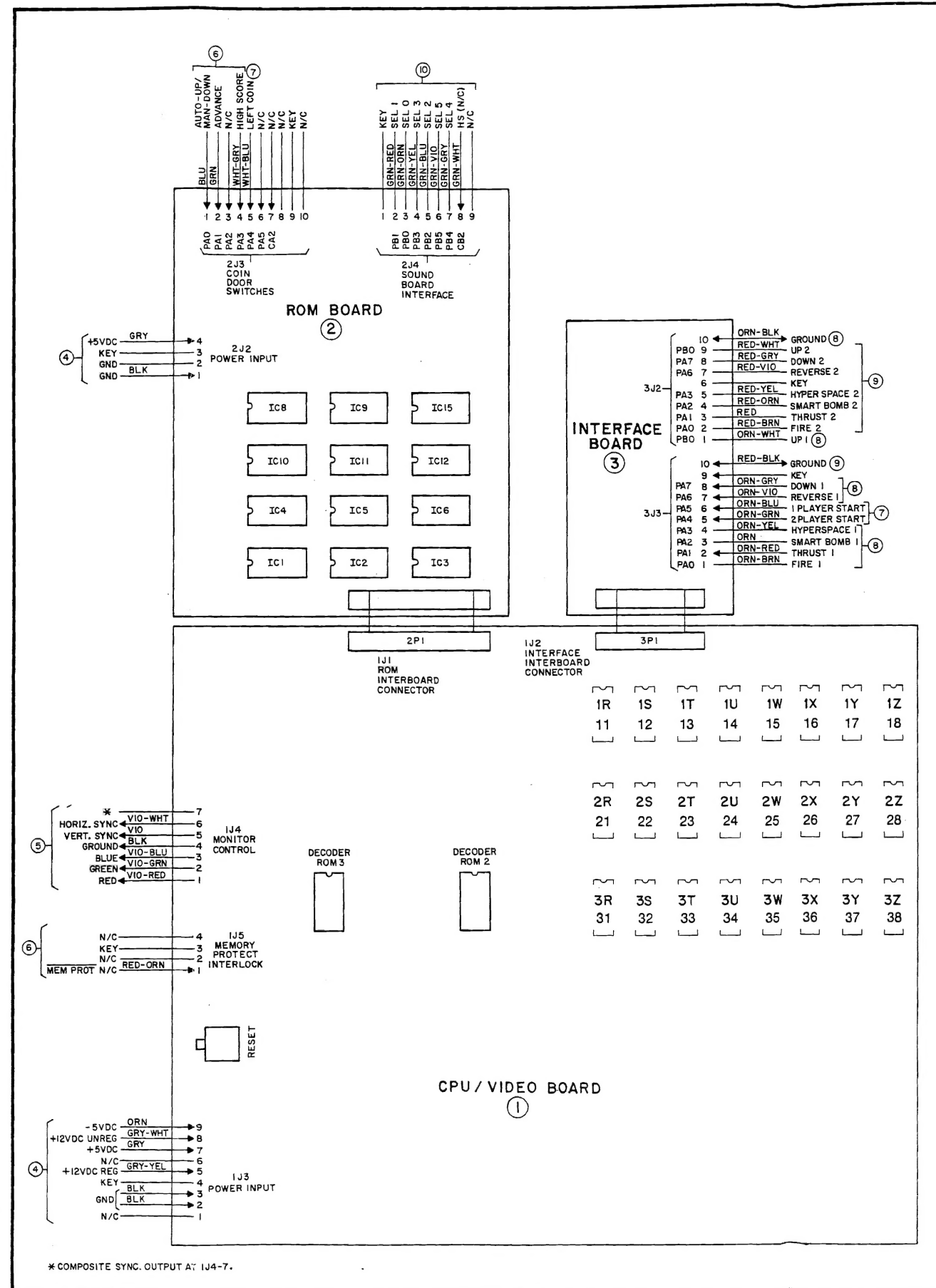
Jumper W1 must be removed and jumper W2 must be connected.

ROM Board

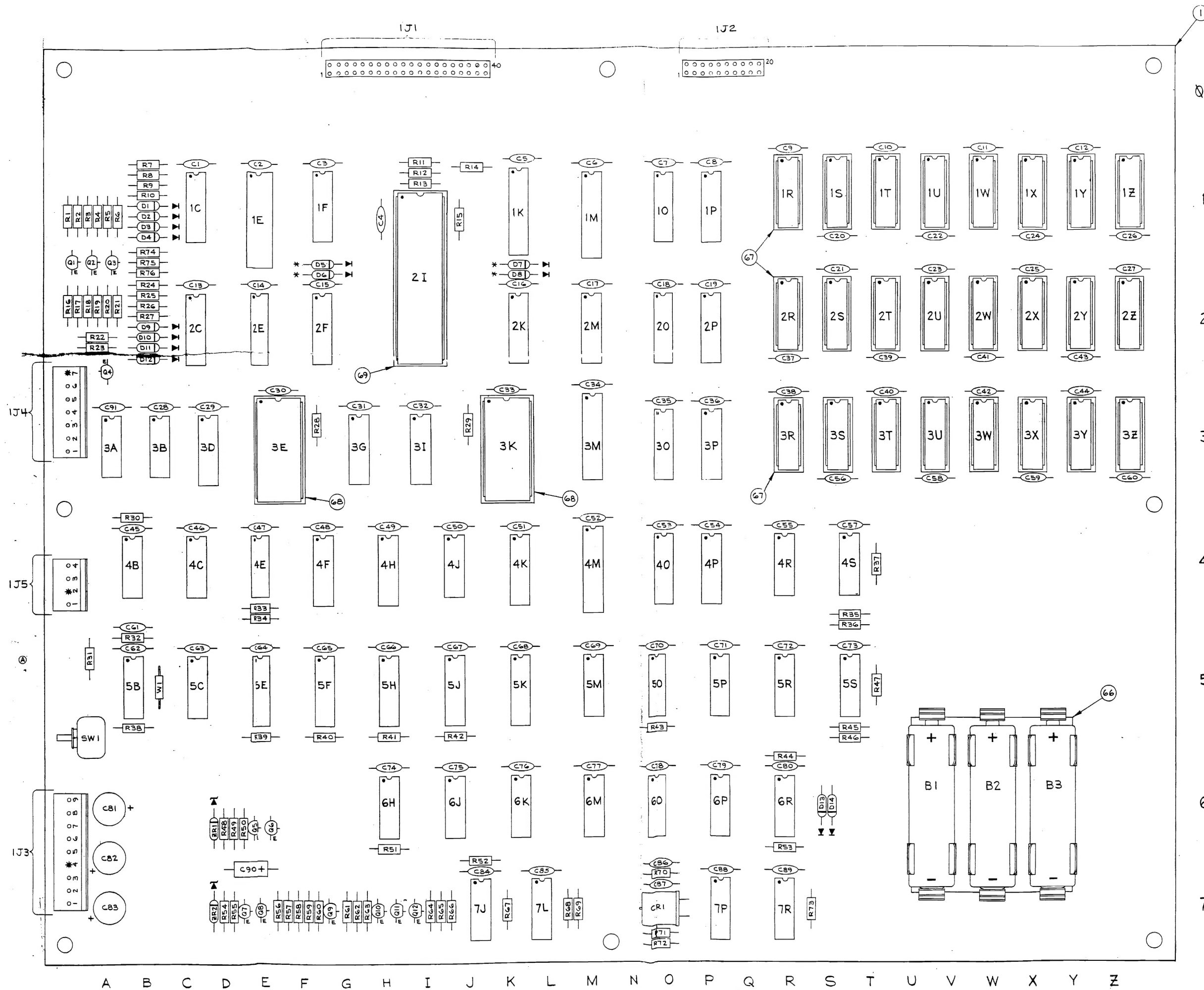
Must be equipped with red-labeled ROMs.

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Interboard Wiring Diagram



1. 4116: 1R, 1S, 1T, 1U, 1W, 1X, 1Y, 1Z,
2R, 2S, 2T, 2U, 2W, 2X, 2Y, 2Z,
3R, 3S, 3T, 3U, 3W, 3X, 3Y, 3Z

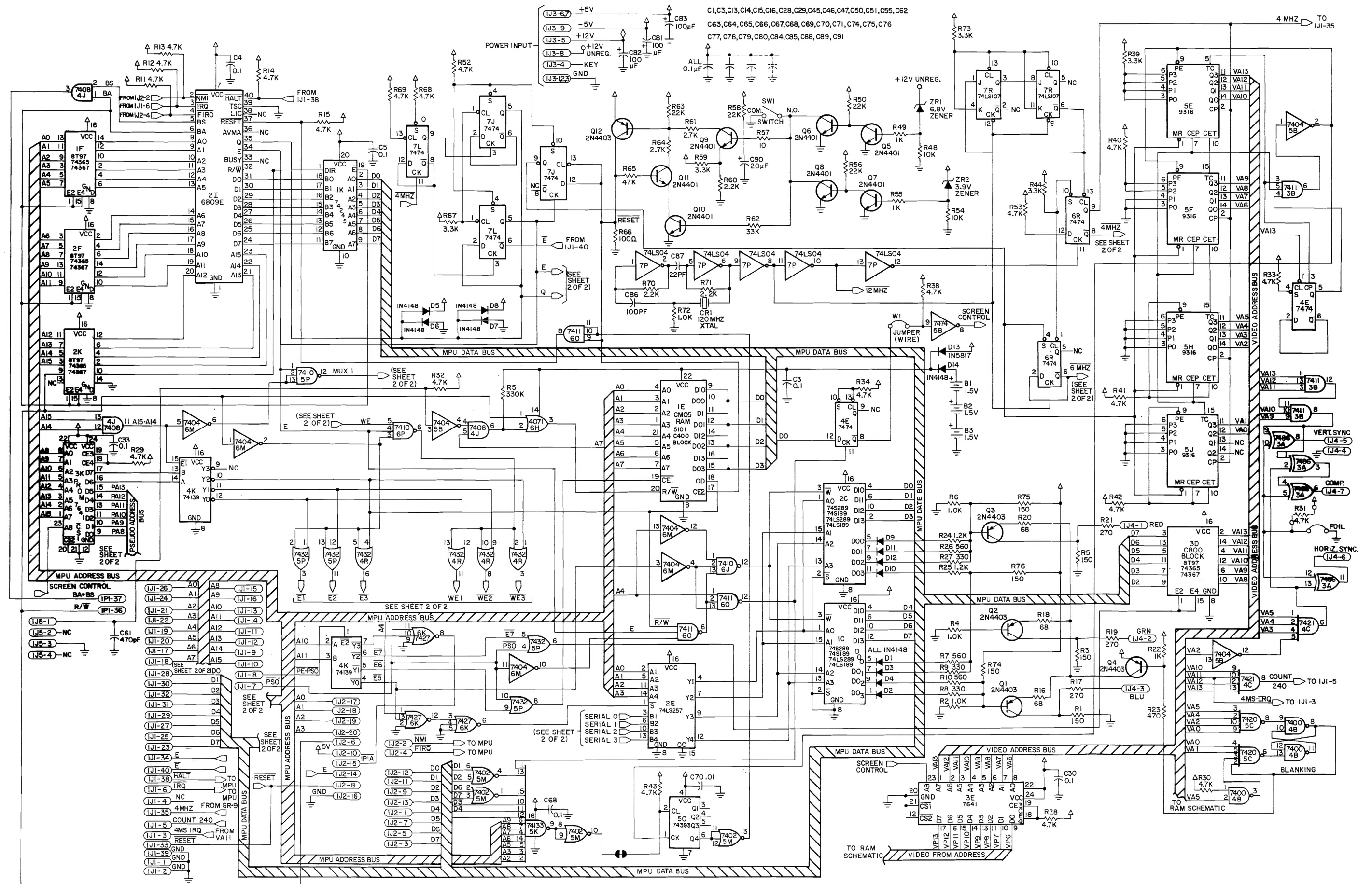
2. 4.7K RESISTOR:
R11, R12, R13, R14, R15, R28, R29,
R30, R31, R32, R33, R34, R35, R36,
R37, R38, R40, R41, R42, R43, R45,
R46, R47, R52, R53, R68, R69

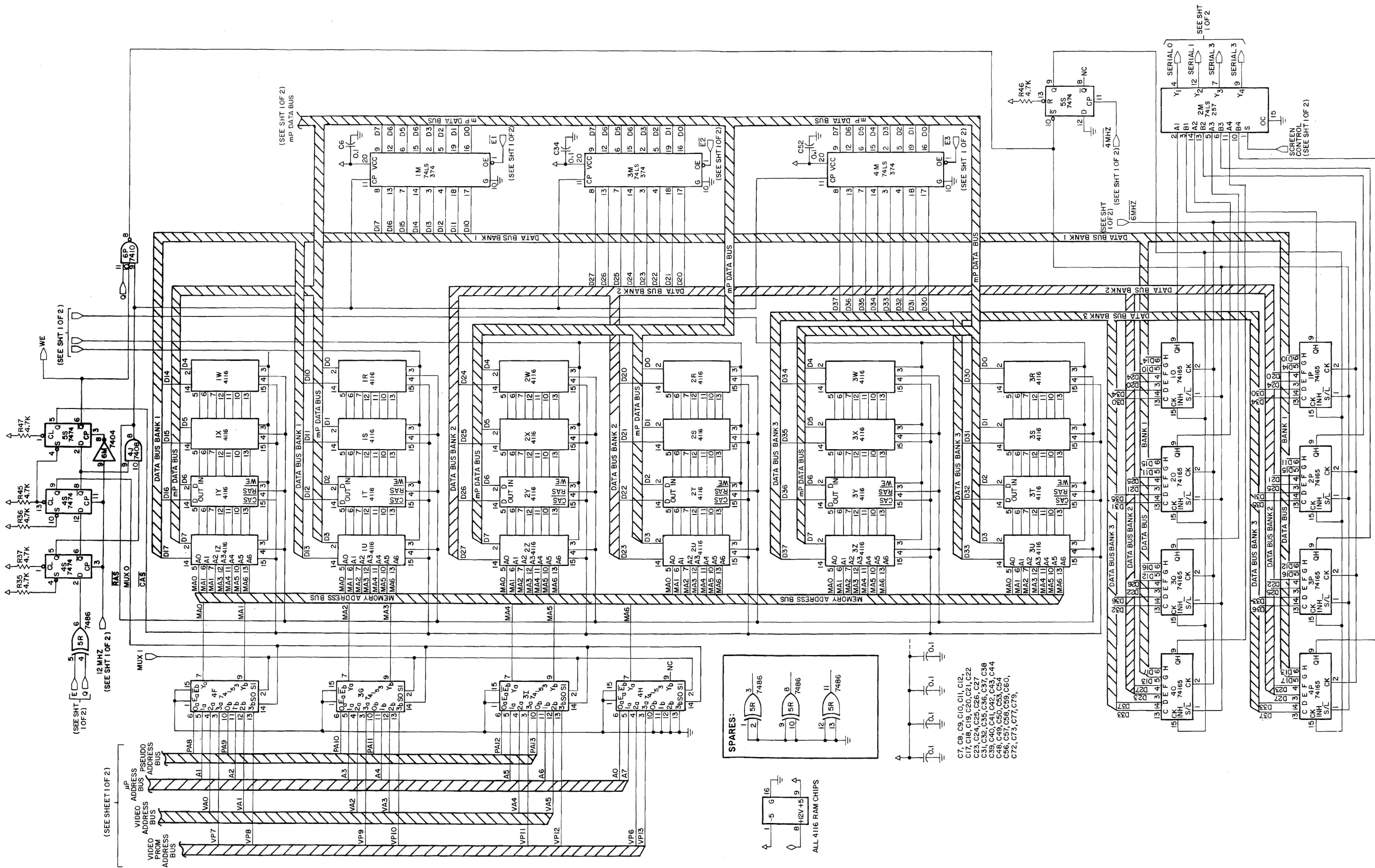
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10,
C11, C12, C13, C14, C15, C16, C17, C18, C19, C20,
C21, C22, C23, C24, C25, C26, C27, C28, C29, C30,
C31, C32, C33, C34, C35, C36, C37, C38, C39, C40,
C41, C42, C43, C44, C45, C46, C47, C48, C49, C50,
C51, C52, C53, C54, C55, C56, C57, C58, C59, C60,
C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71,
C72, C73, C74, C75, C76, C77, C78, C79, C80, C84,
C85, C86, C88, C91

D1, D2, D3, D4, D5, D6, D7,
D8, D9, D10, D11, D12, D14

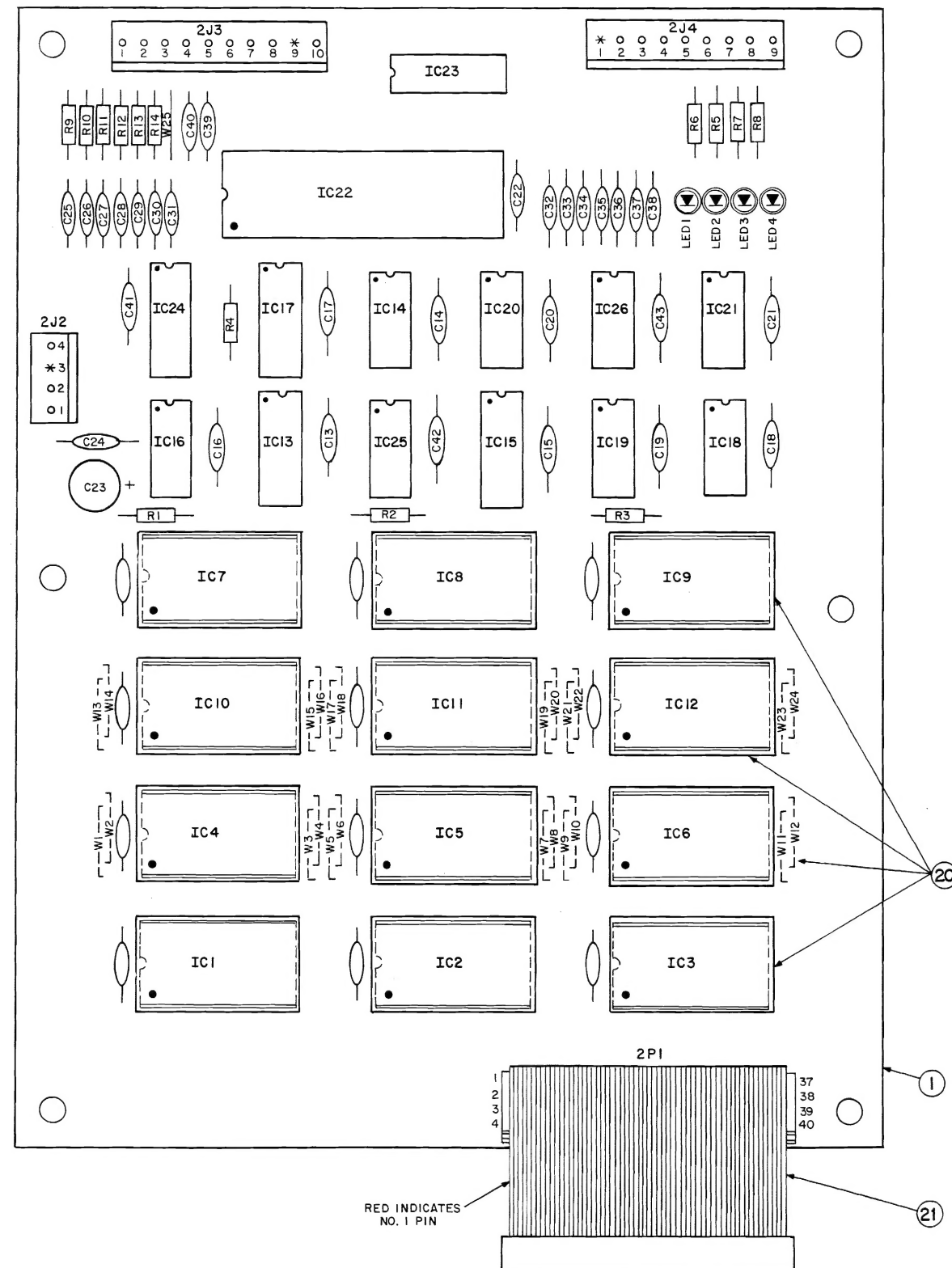
5. *- THESE COMPONENTS ARE NOT USED IN THIS GAME - DEFENDER.

BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESCRIPTION	DESCRIPTION	REQD. NO.
1	5170-0916-00	—	BAKE P.C. BOARD	1
2	5150-09073-00	4B	7400 QUAD 2-INPUT NAND	1
3	5150-0948-00	5M	7407 QUAD 2-INPUT NOR	1
4	5151-09215-00	7P	74LS04 HEX. INVERTER	1
5	5150-09013-00	58,6M	7404 HEX. INVERTER	1
6	5150-08915-00	4J	7408 QUAD AND	1
7	5150-09471-00	6J, 6P	7410 TRIPLE 3-INPUT NAND	2
8	5150-09475-00	35,60	7411 TRIPLE 3-INPUT AND	2
9	5150-09480-00	5C	7420 DUAL 4-INPUT NAND	1
10	5150-09476-00	4C	7421 DUAL 4-INPUT AND	1
11	5150-09477-00	4E, 5P	7432 QUAD 2-INPUT OR	1
12	5150-09478-00	4E, 6R, 7J, 7L	7474 DUAL 4-TYPE FLIP-FLOP	1
13	5150-09479-00	3A, 5R	7486 QUAD 1-INPUT EX-OR	2
14	5150-09480-00	7R	74LS107 DUAL 2-INPUT FLIP-FLOP	1
15	5151-09532-00	5K	74LS133 1-INPUT NAND	1
16	5151-09476-00	4K	74LS159 DUAL 2 to 4 LINE DECODER	1
17	5150-09481-00	36, 31, 4F, 4H	74153 DUAL 4 to 1 DATA INVERT	1
18	5150-09482-00	10, 20, 30, 40, 1P, 2P, 3P, 4P	74154 8-BIT SHIFT REGISTER	5
19	5151-09483-00	1C, 2C	74LS09 or 74LS159 74LS 289 16:4 RAM	2
20	5151-09484-00	1K	74LS178 OCTAL BUS TRANSCEIVER	1
21	5151-09485-00	2E, 2M	74LS257 QUAD DATA MUXPK.	2
22	5151-09486-00	1F, 2F, 2K, 3J	879 HEX. TS. BUFFER	4
23	5151-09487-00	1M, 3M, 4M	74LS157 DUAL 4-TYPE FLIP-FLOP	3
24	5151-09488-00	4% 55	74LS174 DUAL 4-BIT FLIP-FLOP	2
25	5151-09533-00	50	74LS393 DUAL 4-DIGIT BCD COUNTER	1
26	5151-09515-00	3E, 3K	7041 512 X 8 PROM	2
27	5150-09257-00	5H	4071 CMOS QUAD 2-INPUT NOR	1
28	5150-09485-00	5BE NOTE #1	4116 (400 MA ACCESS) 16K X1 DYNAMIC RAM	24
29	5150-09507-00	1E	5101 256 X 4 CMOS RAM	1
30	5150-09489-00	5E, 5F, 5H, 5J	74LS164 4-BIT BIN. COUNTER	4
31	5150-09490-00	2I	6809E MICROPROCESSOR	1
32	5150-09487-00	6K	74LS173 TRIPLE 3-IMP. POKER GAME	1
33	5150-09546-00	R16, R18, R20	RESISTOR, C.F. 68 OHM 2% 1/4 W.	3
34	5150-09508-00	R 66	RESISTOR, C.F. 100 OHM 5% 1/4 W.	1
35	5150-09510-00	R1, R3, R5, R7, R9, R15, R16	RESISTOR, C.F. 150 OHM 5% 1/4 W.	6
36	5150-09509-00	R 23	RESISTOR, C.F. 22 OHM 5% 1/4 W.	1
37	5150-09592-00	R7, R10, R24	RESISTOR, C.F. 50 OHM 5% 1/4 W.	3
38	5150-09510-00	R7, R8, R9, R22, R24, R25, R27	RESISTOR, C.F. 100 OHM 5% 1/4 W.	7
39	5150-09514-00	R24, R25, R27	RESISTOR, C.F. 1.2K OHM 5% 1/4 W.	1
40	5150-09510-00	R60, R70, R71	RESISTOR, C.F. 7.2K OHM 5% 1/4 W.	3
41	5150-09597-00	R61, R64	RESISTOR, C.F. 2.7K OHM 5% 1/4 W.	2
42	5150-09506-00	R39, R44, R59, R67, R78	RESISTOR, C.F. 1.5K OHM 5% 1/4 W.	5
43	5150-09591-00	SEE NOTE #2	RESISTOR, C.F. 4.7K OHM 3% 1/4 W.	27
44	5150-09534-00	R45, R54	RESISTOR, C.F. 1.5K OHM 5% 1/4 W.	2
45	5150-09546-00	R40, R56, R58, R59	RESISTOR, C.F. 22 OHM 5% 1/4 W.	4
46	5150-09518-00	R 62	RESISTOR, C.F. 33K OHM 5% 1/4 W.	1
47	5150-09589-00	R 65	RESISTOR, C.F. 47K OHM 5% 1/4 W.	1
48	5150-09442-00	R 51	RESISTOR, C.F. 330 OHM 5% 1/4 W.	1
49	5150-09501-00	R8, R9, R27	RESISTOR, C.F. 330 OHM 5% 1/4 W.	3
50	5150-09539-00	R 57	RESISTOR, C.F. 10 OHM 5% 1/4 W.	1
51	5043-09515-00	CB7	CAPACITOR, AXIAL 22 PFD. 1K V. 210°	1
52	5043-09492-00	CB6	CAPACITOR, AXIAL 100 PFD. 80 V. 110°	1
53	5043-09490-00	C 90	CAPACITOR, AXIAL 22 PFD. 10 V. 210°	1
54	5043-09565-00	CEE NOTE #3	CAPACITOR, AXIAL 40 PFD. 50 V. XTR	1
55	5043-09566-00	SEE NOTE #3	CAPACITOR, AXIAL 22 PFD. 50 V. 210°	84
56	5043-09421-00	CB1, CB2, CB3	CAPACITOR, RADIAL 100 PFD. 25 V. 150-10°	3
57	5075-09509-00	ER2	1N5950A 3.0 V. ZENER DIODE	1
58	5075-09018-00	2K1	1N5996A 6.8 V. ZENER DIODE	1
59	5070-09519-00	5BE NOTE #4	1N4148 DIODE, SILICON	13
60	5070-09266-00	D13	1N4148 DIODE, SILICON	1
61	5160-09538-00	Q5, Q6, Q7, Q8, Q9, Q10, Q11	2N4401, TO-92 NPN TRANSISTOR, PNP	1
62	5160-09538-00	Q1, Q2, Q3, Q4, Q12	2N4403, TO-92 TRANSISTOR, PNP	1
63	5150-09495-00	CR1	12 MHR CRYSTAL	1
64	5151-09371-00	SW1	PUSH BUTTON SW. PNP (MOMENTARY ON)	1
65	5150-09522-00	B1, B2, B3	BATTERY ALKALINE 1.5V. (AA)	3
66	5151-09521-00	—	BATTERY HOLDER #171	1
67	5150-09006-00	—	16-PIN IC SOCKET	24
68	5150-09006-00	—	24-PIN IC SOCKET	2
69	5150-09585-00	—	40-PIN IC SOCKET	1
70	5191-09587-00	UP4	20 PIN RIBBON CABLE HEADER	1
71	5191-09549-00	IP1	40 PIN RIBBON CABLE HEADER	1
72	5191-09548-00	IP5	4 PIN HEADER OR-65-1041	1
73	5191-09549-00	IP2	7PIN HEADER OR-65-1071	1
74	5191-09549-00	IP3	8PIN HEADER OR-65-1071	1



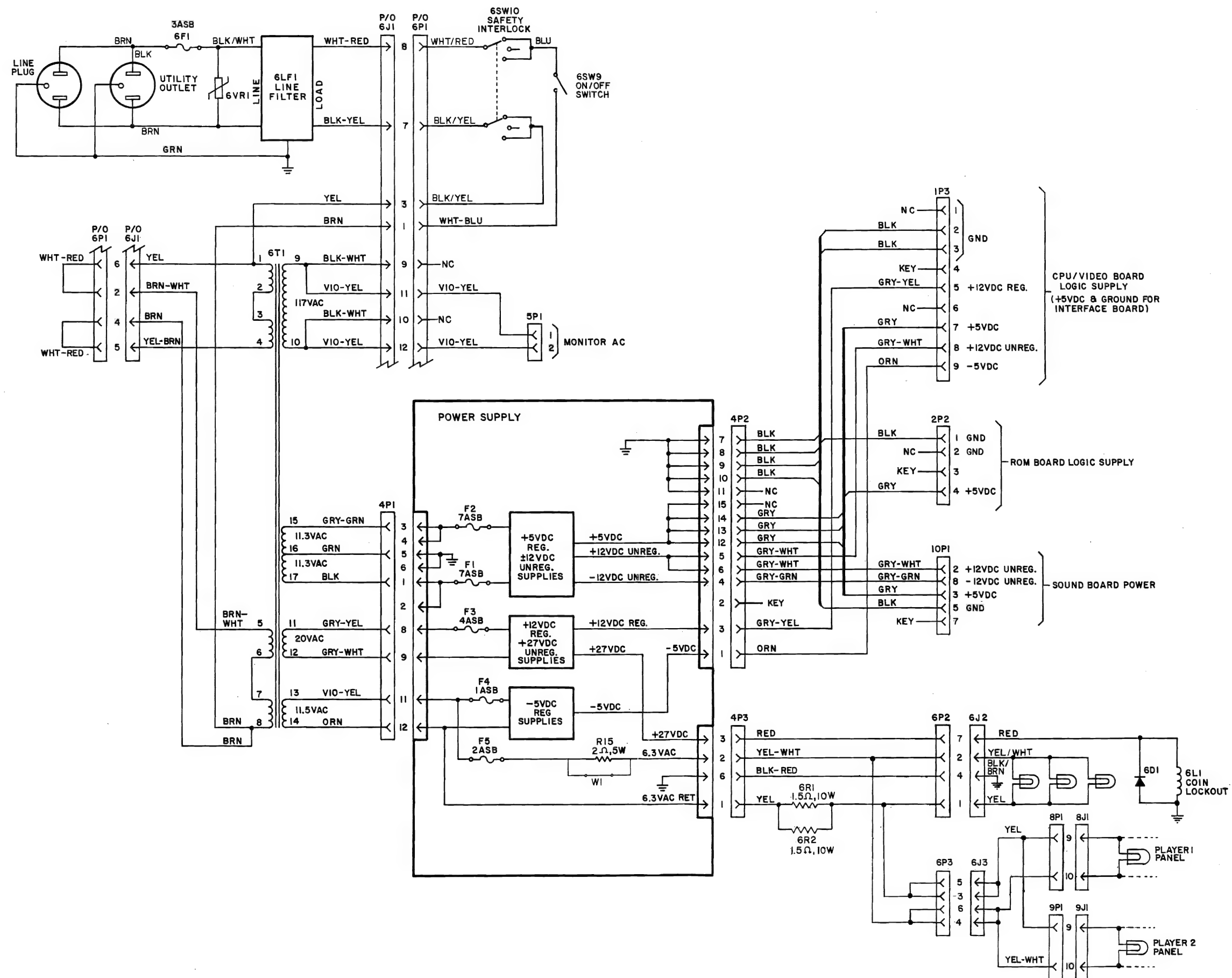


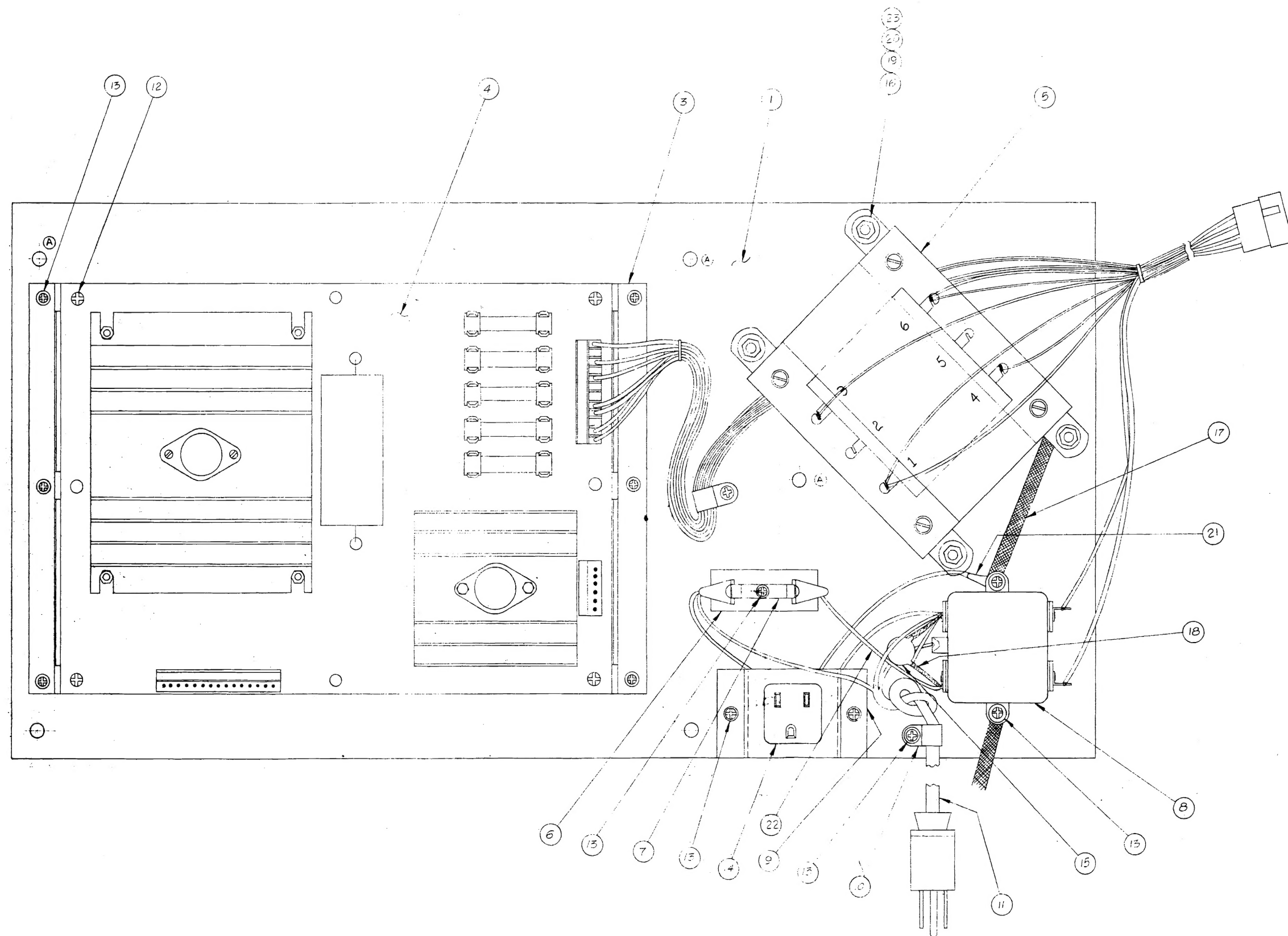
R8570 CPU/Video Board Logic Diagram
(Sheet 2 of 2)



BILL OF MATERIALS				
ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D NO
1	5771-09615-00		BARE P.C. BOARD	1
2	5280-09012-00	IC13	7442 BCD DECODER	1
3	5280-09477-00	IC14, IC16, IC25, IC26	7432 QUAD 2-INPUT OR GATE	4
4	5281-09246-00	IC15	74LS139 DUAL 2 TO 4 LINE DECODER	1
5	5281-09501-00	IC17	74LS395 4-BIT UNIVERSAL SHIFT REG.	1
6	5280-09073-00	IC18	7400 QUAD 2 INPUT NAND	1
7	5280-09013-00	IC19	7404 HEX. INVERTERS	1
8	5280-09551-00	IC20	7425 DUAL 4 INPUT NOR GATES WITH STROBE	1
9	5280-08949-00	IC21	7405 HEX INVERTERS WITH OPEN-COLLECTOR OUTPUTS	1
10	5430-08972-00	IC22	MC6821 PIA	1
11	5019-09239-00	IC23	4.7K 15 RES. 16 PIN DIP PACK	1
12	5671-09019-00	LED 1 THRU LED 4	LED RED	4
13	5010-09001-00	R1 THRU R3	RESISTOR, FC, 330 OHM 5% 1/4 W	7
14	5010-08991-00	R4	RESISTOR, FC, 4.7K OHM 5% 1/4 W	1
15				
16	5043-08980-00	C1 THRU C15, C18 THRU C22, C41-C43	CAP. CERAMIC 0.01 MFD. 50V	24
17	5040-09421-00	C23	CAP. ELECT. 100MFD. 25V	1
18	5043-08996-00	C24	CAP. CERAMIC 0.1 MFD	1
19	5043-09065-00	C17, C25 THRU C28	CAP. CERAMIC, 470 PFD. 50V AXIAL	17
20	5700-09004-00		24 PIN IC SOCKET	12
21	5795-09611-00	2P1	40 PIN RIBBON CABLE ASS'Y, 5"	1
22	5791-09028-00	2J2	4 PIN MALE CONNECTOR 09-65-1041	1
23	5791-09444-00	2J3	10 PIN MALE CONNECTOR 09-65-1101	1
24	5791-09027-00	2J4	9 PIN MALE CONNECTOR 09-65-1091	1
25	5310-08975-00	IC24	4049 INVERTING HEX. BUFFER	1
26	5010-09358-00	R9 THRU R14	RESISTOR, FC, 1K OHM 5% 1/4 W	6
27	5010-09534-00	W1 THRU W25	RESISTOR, FC, 0 OHM	AS REQ'D
28	SEE CHART	IC1 THRU IC12	SEE CHART	AS REQ'D

GAME NAME		"DEFENDER" RED LABEL				
ASSEM. NO.		D-8572-3001				
PART DESIGNATION	IC1	A-5343-09636				
	IC2	A-5343-09637				
	IC3	A-5343-09638				
	IC4	A-5343-09639				
	IC5	NOT USED				
	IC6	A-5343-09640				
	IC7	A-5343-09641				
	IC8	A-5343-09642				
	IC9	A-5343-09643				
	IC10	A-5343-09644				
	IC11	A-5343-09645				
	IC12	A-5343-09646				
JUMPERS		W2, W4, W6, W7, W9, W11, W13, W16, W17, W20, W21, W24				
			PART NUMBER			



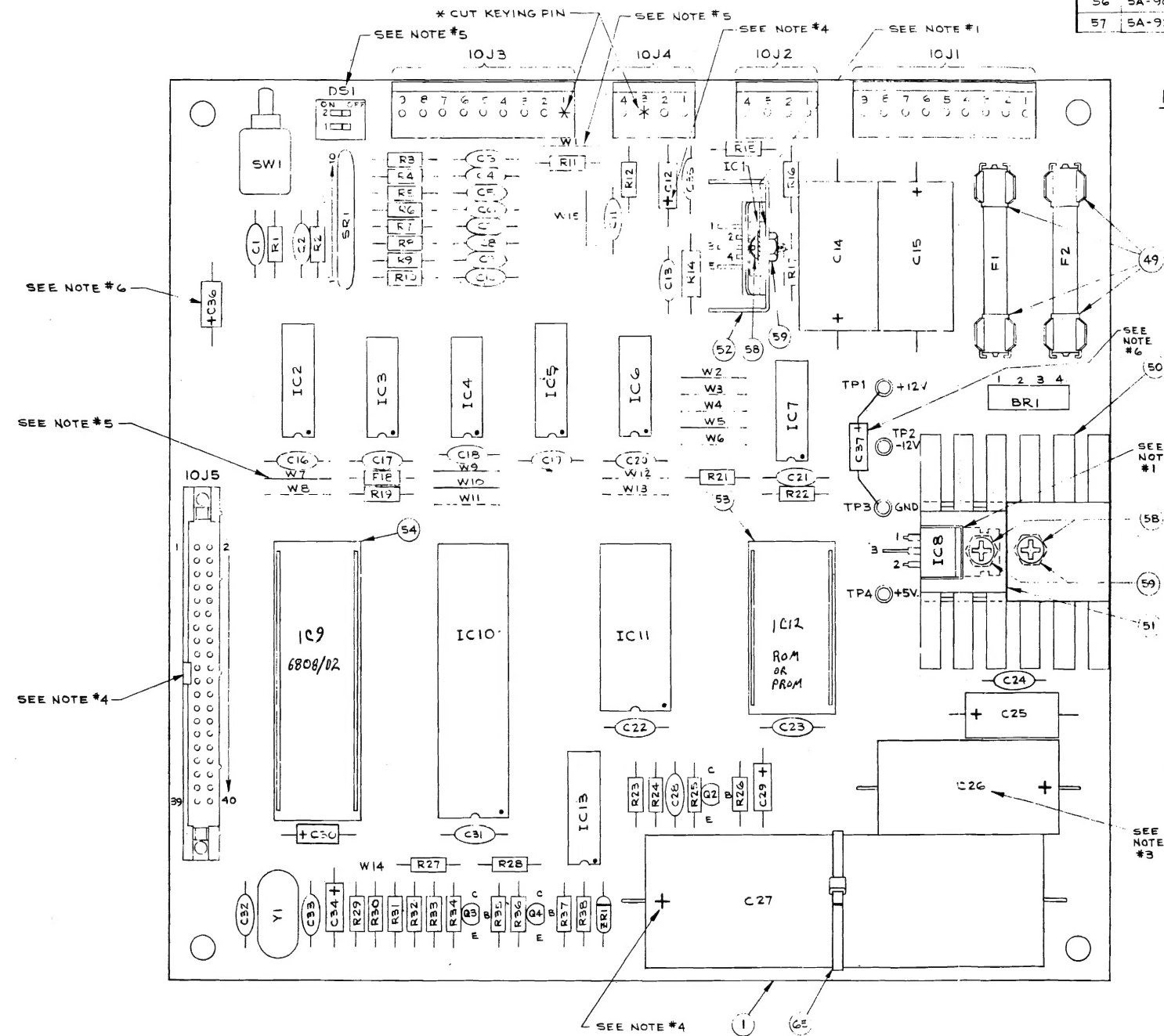


BILL OF MATERIAL			
ITEM	PART NO.	DESCRIPTION	QTY.
1	11-595	POWER SUPPLY MTS. BD	1
2			
3	01-7002	POWER SUPPLY SUPPORT BRKT	2
4	D-8353	POWER SUPPLY BOARD	1
5	C-8653	VIDEO TRANSFORMER ASSY.	1
6	A-6428-1	FUSE MOUNT ASSY.	1
7	5751-08653-00	LINE FUSE 3AMP 115V	1
8	5802-08895-00	LINE FILTER 5A	1
9	01-6948	OUTLET MTS BRACKET	1
10	03-6048-6	CABLE CLAMP-3/8	2
11	SEE NOTE#2	LINE CORD	1
12	4006-0088-04	MS#2-32x1/8 P-RH	4
13	3109-0002-08	MS#2-32x1/8 P-RNH-A	12
14	5851-0818-00	3 WIRE SNAP-IN OUTLET	1
15	SEE NOTE#1	VARIATOR	1
16	4410-01141-00	NUT 10-24 HEX	4
17	20-4002-A	6 INCH BRAIDED GROUND WIRE	1
18	20-9256	1 INCH SLEEVING INSULATION	2
19	4701-02004-00	#10 SPLIT WASHER	4
20	4700-00060-00	3/16x1/2 P.D. 16 GA FLAT WASHER	4
21	5825-06523-00	TERMINAL LUG	1
22	5852-04875-00	BLACK-15 AWG TUMER WIRE-25' L	1
23	4310-01141-00	#10-24 CARRIAGE BOLT 1/4"	4

NOTES:
 1. FOR 115V. A.C. 130V. VARIATOR # 5017-09044 IS USED.
 FOR 230V. A.C. 275V. VARIATOR # 5017-09063 IS USED.
 2. LIVE CORD PART NO.
 5850-08728-00 U.S. DOM
 5850-06206-00 12 FT. EUROPE
 5850-08737-00 AUS.
 5850-06743-00 U.S.L.A.
 5850-09123-00 12 FT. FRANCE
 5850-09131-00 ANG 18-12 JAPAN

ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.	ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
58			6-32 x 1/2" BINDER HEAD SCREW	3	48	5A-9314	F1, F2	4 AMP SLOW BLOW FUSE	2
59			6-32 HEX NUT	3	49	5A-9178		FUSE HOLDER	4
60		W1, W2, W6, W7, W9, W10, W15	WIRE JUMPER 22 GAUGE WIRE WITH INSULATION	7	50	5A-9172		HEAT SINK THERMALLOY #6072B	1
61	FA-9248	TP1 THR TPA	TERMINAL #1502-1	4	51	5A-9173		HEAT SINK THERMALLOY #6071B	1
62	5A-9363	R11	RESISTOR, FC, 15.6 K OHM 5% 1/4 WATT	1	52	5A-9199		HEAT SINK THERMALLOY #6030	1
64	5A-9362	SRI	RESISTOR, 4.7 K OHM 10 PIN SIP	1	53	5A-9004		24 PIN SOCKET	1
65	3A-7520-1		TIE WRAP	1	54	5A-8985		40 PIN SOCKET	1
					55	5A-9027	10J1, 10J3	9 PIN MALE CONNECTOR	2
					56	5A-9028	10J2, 10J4	4 PIN MALE CONNECTOR	2
					57	5A-9349	10J5	40 PIN RIBBON HEADER	1

BILL OF MATERIAL				
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D. NO.
1	1C-2001-146-3		BARE P.C. BOARD	1
2	5A-9156	IC1	TDA2002 V AUDIO AMPLIFIER	1
3	5A-9012	IC2	7442 BCD-DEC DECODER	1
4	5A-9073	IC3	7400 QUAD 2 INPUT NAND	1
5	5A-8973	IC4	7408 QUAD 2 INP. AND GATE	1
6	5A-9153	IC5	4050 BUFFER	1
7	5A-9154	IC6	4068 8 INPUT NAND GATE	1
8	5A-8971	IC7	14069 HEX INVERTER	1
9	5A-9157	IC8	7805 5 VOLT REG. W/TO220 CASE	1
10	5A-8972	IC10	6821 P.I.A.	1
11	5A-9003	IC11	6810 RAM	1
12	5A-9152	IC13	1408 D/A CONVERTER	1
13	5C-8938	Q2, Q3, Q4	2N4401 NPN TRANSISTOR	3
14	5A-9018	ZR1	1N5996 6.8V. ZENER DIODE	1
15				
16	5A-9158	BR1	MDA 200/3N253 BRIDGE RECTIFIER	1
17	5A-9357			
18	5A-9020	Y1	3.58 MHZ CRYSTAL	1
19	5B-8991	R1, R18, R19, R21, R22, R27, R30, R31, R32	RESISTOR, FC, 4.7K OHM 5% 1/4 WATT	9
20	5B-9036	R2 THRU R10	RESISTOR, FC, 100 OHM 10% 1/4 WATT	9
21	5A-8984	R12, R15, R28, R36, R38	RESISTOR, FC, 1K OHM 10% 1/4 WATT	5
22	5A-9181	R14	RESISTOR, FC, 1 OHM 10% 1/2 WATT	1
23	5A-9161	R16	RESISTOR, FC, 2.2 OHM 10% 1/4 WATT	1
24	5A-9361	R17	RESISTOR, FC, 220 OHM 10% 1/2 WATT	1
25				
26	5B-8983	R23, R24, R26	RESISTOR, FC, 3.3K OHM 10% 1/4 WATT	3
27	5A-9179	R25	RESISTOR, FC, 3.3M OHM 10% 1/4 WATT	1
28	5A-9359	R29	RESISTOR, FC, 47K OHM 5% 1/4 WATT	1
29	5B-8817	R33, R35, R37	RESISTOR, FC, 10K OHM 10% 1/4 WATT	3
30	5B-9039	R34	RESISTOR, FC, 10 OHM 10% 1/4 WATT	1
31	5A-8980	C1, C16 THRU C23, C31	CAPACITOR, CERAMIC, .01 MFD. 50 V. ±20%	11
32	5A-9045	C2 THRU C10	CAPACITOR, CERAMIC, .001 MFD. 20% 100 V.	9
33	5A-9345	C11	CAPACITOR, CERAMIC, .001 MFD. 20% 100 V.	1
34	5A-9365	C12, C30, C36	CAPACITOR, ELECTROLYTIC, 1 MFD. 63 V. 10% 50%	3
35	5A-8996	C13, C24, C35	CAPACITOR, CERAMIC, .1 MFD. 50 V. ±20%	3
36	5A-9165 5A-9165-1	C14	CAPACITOR, ELECTROLYTIC, 800 MFD. 16 V. OR 1000 MFD. 15 V. ±20%	1
37	5A-9164 5A-9164-1	C15	CAPACITOR, ELECTROLYTIC, 500 MFD. 15 V. OR 470 MFD. 25 V. ±20%	1
38	5A-8986	C25	CAPACITOR, ELECTROLYTIC, 100 MFD. 10 V. ±20%	1
39	5A-8893	C26	CAPACITOR, ELECTROLYTIC, 1,000 MFD. 25 V. ±20%	1
40	5A-9046	C27	CAPACITOR, ELECTROLYTIC, 12,000 MFD. 16 V. ±20%	1
41	5A-9180	C28	CAPACITOR, CERAMIC, 47 PFD. 1K V. ±20%	1
42	5A-9343	C29	CAPACITOR, ELECTROLYTIC, 10 MFD. 25 V. LOW LEAK. 12%	1
43	5A-9169	C32, C33	CAPACITOR, CERAMIC DISC, 27 PFD. 1K V. ±10%	2
44	5A-9163	C34	CAPACITOR, TANTALUM, 2.2 MFD. 15 V. ±20%	1
45	5A-9031	C37	CAPACITOR, TANTALUM, 1 MFD. 25 V. ±20%	1
46	5A-9024	SW1	MOMENTARY SWITCH 5PDT	1
47	5A-9330	DS1	2 STD. DIP SWITCH	1



NOTES:

- USE THERMAL COMPOUND BETWEEN ICs AND HEAT SINK.
- CAUTION: AVOID STATIC DISCHARGE DAMAGE TO MOS LOGIC.
- SYMBOLS SHOWN ON COMPONENTS ARE FOR REFERENCE ONLY. DO NOT SCREEN OR STAMP.
- OBSERVE INDEX MARK OF ALL INTEGRATED CIRCUITS, DIODES DI1, DI2, AND ZR1.
- CAPACITORS C12, C14, C15, C21, C25, C27, CONNECTORS 10J1, 10J2, 10J4, 10J3, 10J5, POSITION OF TRANSISTORS Q1, Q2, Q3, Q4.
- DS1 - 1 SELECTS SOUNDS/NOTES
- SELECTS SPEECH/NO SPEECH (W9/W4)
- W1 - SPEECH MODULE STATUS
- IN - SPEECH MODULE NOT ATTACHED
- OUT - SPEECH MODULE ATTACHED
- W14 - MPU INTERNAL RAM ENABLE
- W7 & W8 - MEMORY MAP CONTROL
- W12 & W13 - P87 STATUS CONTROL (W13 NEVER USED)
- W4 & W9 - P85 STATUS CONTROL
6. SOLDERED ON TOP OF BOARD
- INSTALL THESE JUMPERS FOR FOLLOWING GAMES:
- W15, W8, W12, W4, W1, W3, W6, W11 FOR:
 - WORLD CUP
 - DISCO FEVER
 - CONTACT
 - POKERINO
 - PHOENIX
 - ARISTOCRAT SHUFFLE
 - POMPLI SHUFFLE
 - KING TUT SHUFFLE
 - TAURUS SHUFFLE
- W15, W8, W12, W4, W1, W2, W5, W10, FOR:
 - FLASH
 - STELLAR WARS
 - TRI ZONK
 - TIME WARP
- W7, W15, W9, W1, (SEE NOTE #5) W2, W5, W10 FOR:
 - GORGAR
 - SOUND ROM 2 - JT-950
- IC12 SELECTION STRAPPING:
 - (2K x 8) W2 IN
 - (1K x 8) W3 IN
 - (512 x 8) W3 IN
 - (512 x 8) W3 IN

